

CLAIMS:

[1] A clamping device for an article to be heat treated for clamping an elongated-shaped article to be heat treated set in a fixed position, constituted such that at least one heat-treated region to be heat treated by quenching after heating and at least one non heat-treated region not to be heat treated are both defined to be extended in a longitudinal direction, and said heat-treated region and said non heat treated region are provided side by side in a width direction orthogonal to the longitudinal direction, clamped at said non heat treated region on an occasion of the heat treatment operation, said clamping device for said article to be heat treated comprising:

a plurality of clamping means arranged in the longitudinal direction of said article to be heat treated,

wherein at least one clamping means including a clamping means nearest to an end in the longitudinal direction among said plural clamping means is a loose clamping means allowing said article to be heat treated to be convex on the side of said heat-treated region.

[2] The clamping device for the article to be heat treated according to claim 1, wherein said plural clamping means comprises a first clamping means and a second clamping means arranged in the longitudinal direction of said article to be heat treated, and the number of said first clamping means is one for the longitudinal direction of said article to be heat treated, and said first clamping means is a tight clamping means holding fixedly said non heat-treated region, whereas the number of said second clamping means arranged apart from said first clamping means along the longitudinal direction is at least one for the longitudinal direction of said article to be heat treated, and said second clamping means is a loose clamping means.

[3] The clamping device for the article to be heat treated according to

claim 1, wherein a position where said non heat-treated region is clamped in each of said plural clamping means is adjustable in the direction orthogonal to the longitudinal direction and the width direction.

[4] The clamping device for the article to be heat treated according to claim 1, wherein the size of a clearance in said loose clamping means to which said non heat-treated region is interposed and arranged is adjustable.

[5] The clamping device for the article to be heat treated according to claim 1, wherein said loose clamping means comprises a movement smoothing means for smoothing the movement of said non heat-treated region of said article to be heat treated in the longitudinal direction.

[6] The clamping device for the article to be heat treated according to claim 1, wherein at least one clamping means out of said plural clamping means is constituted by a toggle mechanism.

[7] The clamping device for the article to be heat treated according to claim 1, wherein said article to be heat treated made of a sheet material has a three-dimensional shape in which a raised portion raised in the direction orthogonal to the longitudinal direction and the width direction as well as extending in the longitudinal direction, and comprises two flange portions extending outward in the width direction from a raised portion base ends on both sides across the width in said raised portion, in which at least one portion of said raised portion is said heat-treated region, and said plural clamping means are arranged in the longitudinal direction of said article to be heat treated in each of said two flange portions where are non heat-treated regions.

[8] The clamping device for the article to be heat treated according to claim 7, wherein said plural clamping means give a load for allowing said article to be heat treated to be convex on one side in the direction orthogonal to the longitudinal direction and the width direction to said non heat-treated

region, and said quenching for said heat treatment operation is performed from the other side in the direction orthogonal to the longitudinal direction and the width direction.

[9] The clamping device for the article to be heat treated according to claim 8,

wherein said plural clamping means comprises a first clamping means and a second clamping means arranged in the longitudinal direction of said article to be heat treated, and the number of said first clamping means is one for the longitudinal direction of said article to be heat treated, and said first clamping means is a tight clamping means holding fixedly said non heat-treated region, whereas the number of said second clamping means arranged apart from said first clamping means along the longitudinal direction are plural in the longitudinal direction of said article to be heat treated, and said second clamping means are loose clamping means, and

wherein said second clamping means are automatic clamping means controlled by a control device, and an order for clamping said article to be heat treated by these second clamping means is controlled by said control device, and the order of clamping is in an order from near said first clamping means.

[10] The clamping device for the article to be heat treated according to claim 9, wherein said first clamping means is an automatic clamping means controlled by a control device, and an order for clamping said article to be heat treated by said first clamping means is controlled by said control device, and the order for clamping is earlier than all said second clamping means.

[11] The clamping device for the article to be heat treated according to claim 8, wherein the side to which said quenching is performed is one side out of inside and outside of said raised portion, and said plural clamping means give a load for pressing and displacing said raised portion base ends

on both sides across the width in said raised portion to said one side out of inside and outside of said raised portion, to said article to be heat treated.

[12] The clamping device for the article to be heat treated according to claim 1, wherein said loose clamping means are arranged in plural in a state apart from each other in the longitudinal direction of said article to be heat treated.

[13] The clamping device for the article to be heat treated according to claim 1, wherein each of said plural clamping means is constituted by including an upper clamping member and a lower clamping member arranged to face each other vertically and said upper clamping member and said lower clamping member are disposed on a work table to which said article to be heat treated is set.

[14] The clamping device for the article to be heat treated according to claim 1, wherein at least one of said plural clamping means is constituted by including an upper clamping member and a lower clamping member arranged to face each other vertically and at least one member of said upper clamping member and said lower clamping member is arranged to a raising and lowering member raised or lowered with respect to the other member.

[15] The clamping device for the article to be heat treated according to claim 14, wherein said lower clamping member is arranged to said raising and lowering member, said article to be heat treated is placed to said lower clamping means, and said article to be heat treated is clamped by said upper clamping member and said lower clamping member with said lower clamping member raised by said raising and lowering member.

[16] The clamping device for the article to be heat treated according to claim 15, wherein the placement of said article to be heat treated to said lower clamping means is performed while said lower clamping means is on the way of being raised by said raising and lowering member.

[17] The clamping device for the article to be heat treated according to claim 16, wherein a rail guiding a travel of a traveling body on which said article to be heat treated is placed is installed at the middle of the height position where said lower clamping member is raised by said raising and lowering member, and said article to be heat treated is transferred from said traveling body to said lower clamping member while said lower clamping member is on the way of being raised by said raising and lowering member.

[18] The clamping device for the article to be heat treated according to claim 15, wherein the placement of said article to be heat treated to said lower clamping means is performed before the lower clamping member begins to be raised by said raising and lowering member.

[19] The clamping device for the article to be heat treated according to claim 18, wherein said raising and lowering member is arranged to a traveling body traveling just below said upper clamping member.

[20] The clamping device for the article to be heat treated according to claim 14, wherein said lower clamping member is arranged to said raising and lowering member, and said upper clamping member is arranged to an immovable member to which a heating device for heating said heat-treated region of said article to be heat treated is installed.

[21] A method of clamping an article to be heat treated, made of a sheet material and having an elongated shape, constituted such that at least one heat-treated region to be heat treated by quenching after heating and at least one non heat-treated region not to be heat treated are both defined to be extended in a longitudinal direction, and said heat-treated region and said non heat-treated region are provided side by side in a width direction orthogonal to the longitudinal direction, having a three-dimensional shape in which a raised portion is provided in the width direction orthogonal to the longitudinal direction, raised in the direction orthogonal to the longitudinal

direction and the width direction as well as extending in the longitudinal direction, and including two flange portions extending outward in the width direction from raised portion base ends on both sides across the width in said raised portion, in which at least one portion of said raised portion is said heat-treated region, said method of clamping an article to be heat treated comprising:

a first step of clamping said article to be heat treated by said first clamping means as being a tight clamping means holding fixedly said non heat-treated region between a first clamping means and a second clamping means arranged in plural in the longitudinal direction,;

a second step of clamping said article to be heat treated by said plural second clamping means as being loose clamping means allowing said article to be heat treated to be convex on the side of said heat-treated region, in which an order for the clamping is in an order from near said first clamping means;

a third step of heating said heat-treated region; and

a fourth step of performing a quenching to said article to be heat treated curved to be convex on one side in the direction orthogonal to the longitudinal direction and the width direction by a load given from said first clamping means and said plural second clamping means, quenching from the other side.